

CLAIMS:

1. A system for use by a surgeon during implantation in a patient of a tibial implant and of a femoral implant in the course of a knee replacement operation, the system

5 comprising:

a computer having memory for holding data relating to size and shape of at least one tibial implant and at least one femoral implant as well as data obtained during pre-operative scanning of the patient relating to the tibia and femur of the patient and also data relating to the three dimensional position and orientation of at least one bone selected from the patient's tibia and the patient's femur obtained during the course of the knee replacement operation;

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display means for displaying images derived from data held in the memory of the computer relating to the patient's tibia, to the patient's femur, to the at least one tibial implant, and to the at least one femoral implant;

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registration means for registering the three dimensional position and orientation of the at least one bone during the course of the knee replacement operation;

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detector means connected to the computer and operatively coupled to the registration means for detecting the position and orientation of the at least one bone and for supplying to the memory of the computer data relating to the three dimensional position and orientation of at least one bone selected from the patient's tibia and the patient's femur obtained during the course of the knee replacement operation; and

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tensor means for applying tension to the ligaments of the patient's knee in flexion or in extension;

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the computer being programmed to display on the display means, *inter alia*, one or more of the following images derived from data held in the memory of the computer and

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depicting the position and orientation of:-

- (i) the patient's tibia and the patient's femur with the knee tensed by the tensor means in flexion;
- (ii) the patient's tibia and the patient's femur with the knee tensed by the tensor means in extension;
- (iii) the patient's tibia and the patient's femur with the knee tensed by the tensor means in flexion and potential planes of cut for resection of the patient's femur;
- (iv) the patient's tibia and the patient's femur with the knee tensed by the tensor means in extension and potential planes of cut for resection of the patient's femur;
- (v) the patient's tibia and the patient's femur with the knee tensed by the tensor means in flexion and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof; and
- (vi) the patient's tibia and the patient's femur with the knee tensed by the tensor means in extension and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof.
2. A system according to claim 1, wherein the registration means comprises first marker means for attachment to the patient's tibia, second marker means for attachment to the patient's femur, and pointer means for touching significant features on the patient's tibia and femur, and wherein the first marker means, the second marker means, and the pointer means are all adapted for operative coupling to the detector means.
3. A system according to claim 2, wherein the detector means comprises an infra-red camera, and wherein the first marker means, the second marker means, and the pointer means each carry infra-red reflector means.

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4. A system according to claim 2, wherein the detector means comprises an ultrasonic emitter or receiver, and wherein the first marker means, the second marker means, and the pointer means each carry ultrasonic reflector or emitter means.

5. A system according to any one of claims 1 to 4, wherein the tensor means comprises an inflatable balloon.

6. A system according to any one of claims 1 to 4, wherein the tensor means is selected from a hydraulic bag, a

mechanical device having two parallel motion paddles, a mechanical device having a swivelling motion top paddle, a mechanical device having separate medial and lateral top paddles, a mechanical device having one central arm on to the femur, and a mechanical device having only a medial separation.

7. A system for use by a surgeon during a knee replacement operation, the system comprising:

a computer having memory for holding data relating to size and shape of at least one tibial implant and at least one femoral implant as well as data obtained during pre-operative scanning of the patient relating to the tibia and femur of the patient and also data relating to the three dimensional position and orientation of at least one bone selected from the patient's tibia and the patient's femur obtained during the course of the knee replacement operation;

display means for displaying images derived from data held in the memory of the computer relating to the patient's tibia, to the patient's femur, to the at least one tibial implant, and to the at least one femoral implant; and

detector means connected to the computer and operatively coupled to registration means for registering the three dimensional position and orientation of the at least one bone during the course of the knee replacement operation, the

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detector means supplying to the computer data relating to the three dimensional position and orientation of the at least one bone;

the computer being programmed to display on the display means, *inter alia*, one or more of the following images derived from data held in the memory of the computer and depicting the position and orientation of:-

(i) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in flexion;

(ii) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension;

(iii) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in flexion and potential planes of cut for resection of the patient's femur;

(iv) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension and potential planes of cut for resection of the patient's femur;

(v) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in flexion and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof; and

(vi) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof.

8. A computer program for controlling a computer forming part of a system for use by a surgeon during a knee

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replacement operation, the system comprising:

a computer having memory for holding data relating to size and shape of at least one tibial implant and at least one femoral implant as well as data obtained during pre-operative scanning of the patient relating to the tibia and femur of the patient and also data relating to the three dimensional position and orientation of at least one bone selected from the patient's tibia and the patient's femur obtained during the course of the knee replacement operation;

display means for displaying images derived from data held in the memory of the computer relating to the patient's tibia, to the patient's femur, to the at least one tibial implant, and to the at least one femoral implant; and

detector means connected to the computer and operatively coupled to registration means for registering the three dimensional position and orientation of the at least one bone during the course of the knee replacement operation, the detector means supplying to the computer data relating to the three dimensional position and orientation of the at least one bone;

the computer program being recorded on a recording medium and arranged to display on the display means, *inter alia*, one or more of the following images derived from data held in the memory of the computer and depicting the position and orientation of:-

(i) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in flexion;

(ii) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension;

(iii) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed

by a tensor means in flexion and potential planes of cut for resection of the patient's femur;

(iv) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension and potential planes of cut for resection of the patient's femur;

(v) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in flexion and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof; and

(vi) the patient's tibia and the patient's femur before or after resection of the tibia with the knee tensed by a tensor means in extension and with at least one component selected from the tibial component and the femoral component as it will appear after implantation thereof.

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